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			EXAMINER	
			JOHNSON, BRIAN P	
		ART UNIT	PAPER NUMBER	
		2183		

DATE MAILED: 09/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/717,747

Applicant(s)

EICKEMEYER ET AL.

Examiner

Brian P. Johnson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 June 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

1. Claims 1-22 have been examined.

Acknowledgment of papers filed: remarks and affidavit filed on 29 June 2006.

The papers filed have been placed on record.

Specification

2. The title is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-2 and 9-13 are rejected under 35 U.S.C. 102(b) as being anticipated by Doing (U.S. Patent No. 6,348,671).
5. Regarding claim 1, Doing discloses an integrated circuit processor (col 2 lines 52-53) comprising: a first instruction buffer (fig 2 reference 203) corresponding to a primary thread (col 7 lines 55-56); a second instruction buffer (fig 2 reference 204) corresponding to a backup thread (col 7 lines 60-64); a thread switch mechanism that detects when the primary thread stalls (col 14 lines 21-27), and in response thereto,

swaps information stored in the first instruction buffer with information stored in the second instruction buffer (col 14 lines 4-9 and col 11 lines 51-62).

6. Regarding claim 2, Doing discloses the integrated circuit processor of claim 1 wherein execution of the backup thread occurs after the swap by executing at least one instruction in the first instruction buffer (col 7 line 52 to col 8 line 3).

Note that, after the instructions have been swapped, the backup instructions (considered to be "execution of the backup thread") are executed by collecting these instructions from the sequential buffer (also known as the "first instruction buffer").

7. Regarding claim 9, Doing discloses a method for switching between a first thread of execution and a second thread of execution in a multithreaded processor (col 7 line 52 to col 8 line 3), the method comprising the steps of: (A) providing a first instruction buffer (fig 2 reference 203) corresponding to the first thread (col 7 lines 55-56); (B) providing a second instruction buffer corresponding to the second thread (fig 2 reference 204 and col 7 lines 60-64); (C) swapping information stored in the first instruction buffer with information stored in the second instruction buffer (col 7 line 52 to col 8 line 3).

8. Regarding claim 10, Doing discloses the method of claim 9 wherein step (C) is performed when switching between the first thread and the second thread is required (col 7 lines 60-64).

9. Regarding claim 11, Doing discloses the method of claim 9 wherein step (C) is performed when the first thread stalls (col 14 lines 21-27).

10. Regarding claim 12, Doing discloses the method of claim 9 wherein step (C) is performed when the second thread stalls (col 14 lines 21-27).

Note that the thread mechanisms are considered to be symmetric. See claim 8.

11. Regarding claim 13, Doing discloses the method of claim 9 further comprising the step of executing the second thread after the swapping of information in step (C) by executing at least one instruction in the first instruction buffer (col 7 line 52 to col 8 line 3).

See claim 2.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 3-6, 8, and 14-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doing in view of Shoemaker (U.S. Publication No. 2003/0135711).

14. Regarding claim 3, Doing discloses the integrated circuit processor of claim 1.

Doing fails to disclose a third or fourth instruction buffer that swap instructions in a similar fashion as the first and second instruction buffer.

Shoemaker discloses the technique of Simultaneous Multi-Threading (paragraph 6).

It is expected that one of ordinary skill in the art would appreciate the fact that additional parallelism in a processing system allows for additional throughput. The technique of Simultaneous Multi-Threading is well known and has the advantages of allowing "multiple threads to share and to compete for processor resources at the same time". Doing, a processing system concerned with latency during stalls would be motivated to incorporate this technique to allow "the SMT system to continue executing useful work during a cache miss".

It would have been obvious at the time of the invention for one of ordinary skill in the art to add SMT capabilities (as in Shoemaker) to the computing system of Doing in such a way that the primary and backup threads are replicated to create a "third" and "fourth" instruction buffer, also considered to be secondary primary and backup buffers.

Note that, logically, it would be obvious to simply replicate portions of the original invention of Doing to allow for SMT capabilities. For that reason, future references to third and forth buffers will be treated the same way as the first and second buffers, disclosed by Doing alone. Consequently, Doing/Shoemaker discloses the remaining limitations.

15. Regarding claim 4, Doing/Shoemaker discloses the integrated circuit processor of claim 3 wherein the first and second primary threads simultaneously issue instructions for execution (Shoemaker paragraph 6).

16. Regarding claim 5, Doing/Shoemaker discloses an integrated circuit processor (col 2 lines 52-53) comprising: a first primary instruction buffer (col 2 lines 52-53) corresponding to a first primary thread (fig 2 reference 203); a second primary instruction buffer corresponding to a second primary thread (see claim 3); wherein the first and second primary threads simultaneously issue instructions for execution (Shoemaker paragraph 6); a first backup instruction buffer (col 7 lines 55-56); a second backup instruction buffer; a thread switch mechanism that detects when one of the first and second threads stalls (col 14 lines 21-27), and in response thereto, swaps information stored in one of the first and second primary instruction buffers corresponding to the stalled thread with information stored in one of the first and second backup instruction buffers (col 7 line 52 to col 8 line 3).

17. Regarding claim 6, Doing/Shoemaker discloses the integrated circuit processor of claim 5 wherein the thread switch mechanism: (1) detects when the first primary thread stalls (col 14 lines 21-27), and in response thereto, swaps the first primary instruction buffer with the first backup instruction buffer (col 7 line 52 to col 8 line 3); and (2) detects when the second thread stalls (col 14 lines 21-27), and in response thereto,

swaps the second primary instruction buffer with the second backup instruction buffer (col 7 line 52 to col 8 line 3).

Note that, as discussed in the combination above, the third/fourth threads (second primary and backup threads) are considered to act in a similar fashion as the first and second threads.

18. Regarding claim 8, Doing/Shoemaker discloses an integrated circuit processor (col 2 lines 52-53) comprising: a first primary instruction buffer corresponding to a first primary thread (fig 2 reference 203); a second primary instruction buffer corresponding to a second primary thread (col 7 lines 55-56); wherein the first and second primary threads simultaneously issue instructions for execution; a first backup instruction buffer (col 7 lines 55-56); a second backup instruction buffer; a thread switch mechanism that detects when the first thread stalls (col 14 lines 21-27), and in response thereto, begins issuing from the first backup instruction buffer, and that detects when the second thread stalls, and in response thereto, begins issuing from the second backup instruction buffer (col 14 lines 21-27).

Note that the distinction between the first and second primary threads do not matter, because the each primary thread are considered to be symmetric.

19. Regarding claim 14, Doing discloses the method of claim 9 further comprising the steps of: (D) providing a third instruction buffer corresponding to a third thread (fig 2 reference 203); (E) providing a fourth instruction buffer corresponding to a fourth thread

(fig 2 reference 204); and (F) swapping information stored in the third instruction buffer with information stored in the fourth instruction buffer (col 7 lines 60-64).

20. Regarding claim 15, Doing discloses the method of claim 14 wherein step (F) is performed when the third thread stalls (col 14 lines 21-27).

21. Regarding claim 16, Doing discloses the method of claim 14 wherein step (F) is performed when the fourth thread stalls (col 14 lines 21-27).

22. Regarding claim 17, Doing discloses the method of claim 14 wherein the first and third threads simultaneously issue instructions for execution (Shoemaker paragraph 6).

23. Regarding claim 18, Doing discloses a method for switching between first and second threads (col 7 line 52 to col 8 line 3) of execution in a multithreaded processor (col 5 lines 10-14), the method comprising the steps of: (A) providing a first primary instruction buffer corresponding to the first thread (fig 2 reference 203 and col 7 lines 55-56); (B) providing a second primary instruction buffer corresponding to the second thread (see claim 3); (C) providing a first backup instruction buffer corresponding to a first backup thread (fig 2 reference 204 and col 7 lines 60-64); (D) providing a second backup instruction buffer corresponding to a second backup thread; (E) simultaneously issuing instructions from the first primary instruction buffer and from the second primary instruction buffer; and (F) detecting when one of the first and second primary threads

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stalls (col 14 lines 21-27 and col 7 lines 60-64), and in response thereto, swapping information stored in one of the first and second primary instruction buffers corresponding to the stalled thread with information stored in one of the first and second backup instruction buffers (col 7 line 52 to col 8 line 3).

24. Regarding claim 19, Doing discloses the method of claim 18 wherein step (E) comprises the steps of: (1) detecting when the first primary thread stalls (col 14 lines 21-27), and in response thereto, swapping information stored in the first primary instruction buffer with information stored in the first backup instruction buffer (col 7 line 52 to col 8 line 3); and (2) detecting when the second thread stalls, and in response thereto, swapping information stored in the second primary instruction buffer with information stored in the second backup instruction buffer (col 7 line 52 to col 8 line 3).

25. Claims 7 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doing/Shoemaker in view of Levy (U.S. Patent No. 6,314,511).

26. Regarding claim 7, Doing discloses the integrated circuit processor of claim 5.

Doing/Shoemaker fails to disclose a pool of backup buffers.

Levy discloses the use of a pool of registers to be used for register renaming during a context switch (col 12 lines 34-45).

Doing/Shoemaker (as previously combined) has a single backup thread for each primary thread. This technique can allow for useful processing during a cache miss;

however, utilizing a technique analogous to Levy would allow for "the most flexible technique for managing" the instruction buffers (Levy col 12 lines 35-36). More flexibility for thread switching allows for better utilization of processor resources during a latency situation caused by a cache miss.

It would have been obvious at the time of the invention for one of ordinary skill in the art to allow the computing system of Doing/Shoemaker to utilize a system analogous to the register renaming system of Levy in which a pool of threads can be used to backup the primary threads, rather than just a single backup option. This way, any backup instruction buffer in the pool may be swapped with information in the first primary instruction buffer and information in any backup instruction buffer in the pool may be swapped with information in the secondary primary buffer (col 12 lines 36-41).

27. Regarding claim 20, Doing/Shoemaker/Levy discloses the method of claim 18 wherein the first and second backup instruction buffers are part of a pool of backup instruction buffers (Levy col 12 lines 34-45), wherein information in any backup instruction buffer in the pool may be swapped with information in the first primary instruction buffer (col 12 lines 36-41), and wherein information in any backup instruction buffer in the pool may be swapped with information in the second primary instruction buffer (col 12 lines 36-41).

28. Claims 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doing/Shoemaker in view of Redington (U.S. Patent No. 6,957,326).

29. Regarding claim 21, Doing discloses a method for switching between threads of execution in a multithreaded processor (col 7 line 52 to col 8 line 3), the method comprising the steps of: (A) providing a first primary instruction buffer corresponding to the first thread (fig 2 reference 203 and col 7 lines 55-56); (B) providing a second primary instruction buffer corresponding to the second thread (see claim 3); (C) providing a first backup instruction buffer corresponding to a first backup thread (fig 2 reference 204 and col 7 lines 60-64); (D) providing a second backup instruction buffer corresponding to a second backup thread; (E) simultaneously issuing instructions from the first primary instruction buffer and from the second primary instruction buffer (Shoemaker paragraph 6); and (F) detecting when the first threads stalls (col 14 lines 21-27).

Doing/Shoemaker fails to disclose issuing from a backup instruction buffer rather than the primary instruction buffer.

Redington discloses, during a context switch, allowing register sets to switch roles from primary to secondary and vice versa (col 4 lines 31-39).

It is expected that Doing/Shoemaker as well as others of ordinary skill appreciate the advantage of power consumption in a processor. The technique disclosed in Doing/Shoemaker of exchanging instruction information is effective, but not necessarily power efficient. For that reason, Doing/Shoemaker would be motivated to utilize a technique that required less information transfer and, therefore, less power consumption during a context switch.

It would have been obvious at the time of the invention for one of ordinary skill in the art to allow the computing system of Doing/Shoemaker to reverse the roles of the primary and secondary instruction buffers (similar to the registers disclosed in Redington) in such a way that after a thread change, instructions will be executed from the previously secondary (currently primary) instruction buffer.

30. Regarding claim 22, Doing discloses the method of claim 21 further comprising the step of (G) detecting when the second thread stalls, and in response thereto, issuing from the second backup instruction buffer instead of issuing from the second primary instruction buffer (Redington col 4 lines 31-39).

Claim Rejections - 35 USC § 102

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

31. Rejection under Luick (U.S. Publication No. 2005/0081018) has been withdrawn.

Response to Arguments

32. Applicant's arguments filed 29 June 2006 have been fully considered but they are not persuasive.

33. Applicant states:

“The express teachings of Doing indicate the contents of the sequential hold buffer and the thread switch buffer are not swapped. In Doing, when there is a thread switch, the inactive thread becomes the active thread, and the active thread becomes the inactive thread as taught on column 14, lines 22-24. When a thread is switched from inactive to active, there is not swapping or moving of instructions between the sequential hold buffer and the thread switch buffer. To the contrary, the decode/dispatch logic 206 simply chooses a different buffer as the source of the next instruction.”

Examiner agrees; however, Examiner reminds Applicant of the wording disclosed in claim 1: “swaps information stored in the first instruction buffer with information stored in the second instruction buffer”. Examiner agrees that all information is not swapped, but Applicant appears to ignore disclosure of Doing cited within the original office action—in particular, col 14 lines 4-9 and col 11 lines 51-62. These citations clearly indicate information that is swapped between the two buffers.

34. Applicant states:

“It is significant to note that the sequential hold buffer 203 and the thread switch buffer 204 in FIG. 2 of Doing do not have a path that connects them. This means that swapping the contents of the sequential hold buffer 203 and the thread switch buffer 204 as suggested by the examiner is physically impossible in Doing.”

Examiner asserts that Applicant's belief that Fig. 2 discloses every possible connect between the various elements shown is simply not true. The figure is a

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conceptual tool to learn the most prominent functionality. The lack of a pictured arrow does not render any communications “physically impossible” as Applicant contends.

35. Applicant states:

“Luick reference should be removed as prior art under 35 USC 102(e).”

Examiner agrees. The rejection has been withdrawn.

36. Examiner asserts that the remaining arguments appear to all follow the incorrect assumption that Doing does not disclose all the limitations of claim 1. With that fallacy clarified, it appears that the remaining rejections follow logically as disclosed in Examiner's previous action.

37. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian P. Johnson whose telephone number is (571) 272-2678. The examiner can normally be reached on 8-4:30 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


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